Muon Tracker Focus

By
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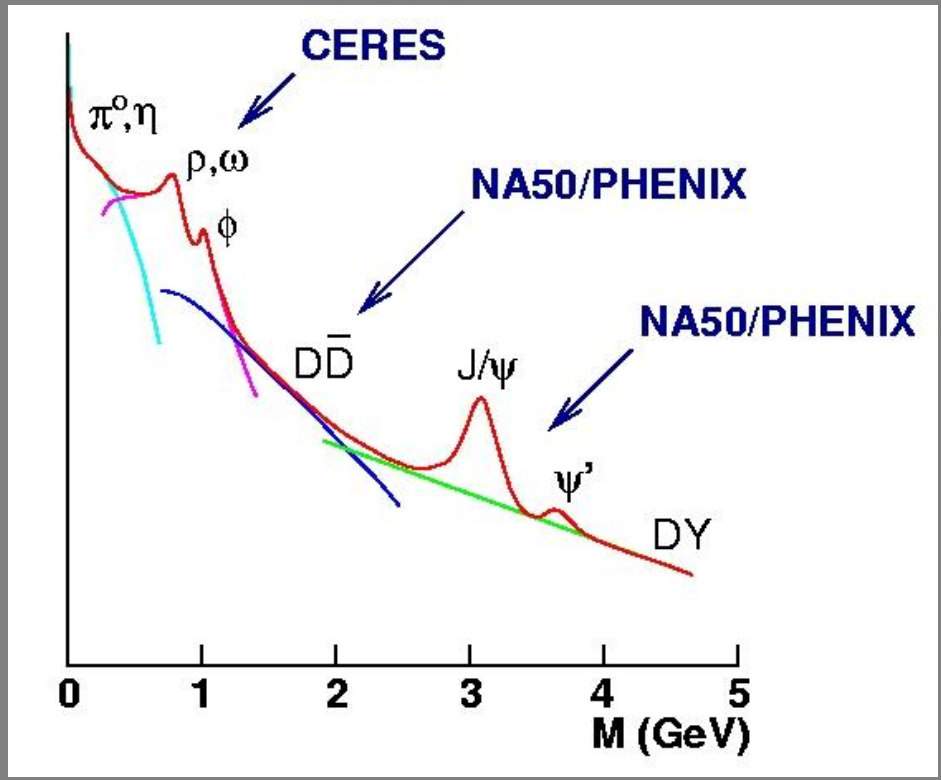
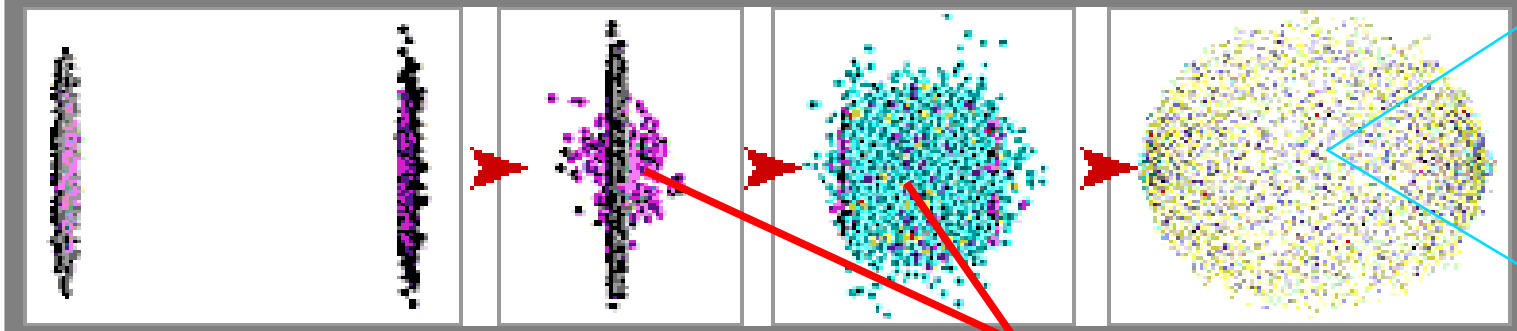
Outline

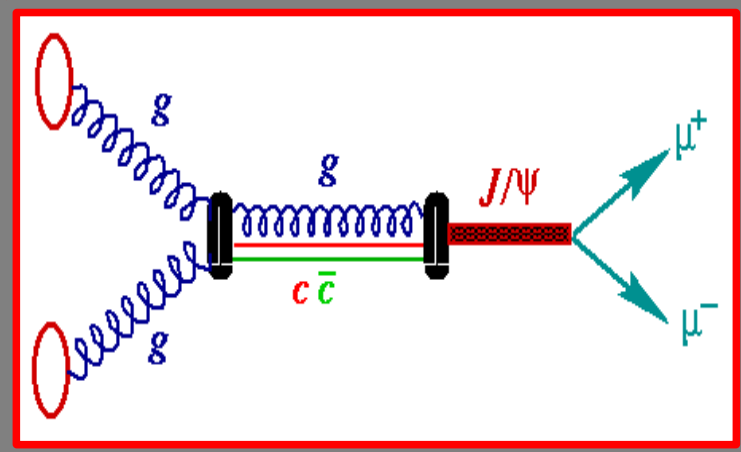
- Physics goals of Muon Trackers
  - ⋆Quark Gluon Plasma
  - ⋆Spin physics
- Design
  - ⋆Tracking Chambers
  - ⋆FEE & HV
  - ⋆Performances
- Results
  - ⋆From the last run (QM02)
  - ⋆First look at d-Au
- Summary



Quark Gluon Plasma

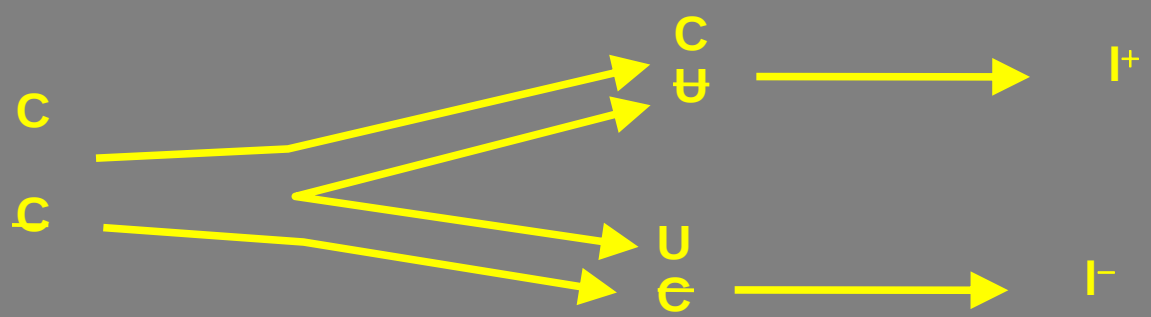


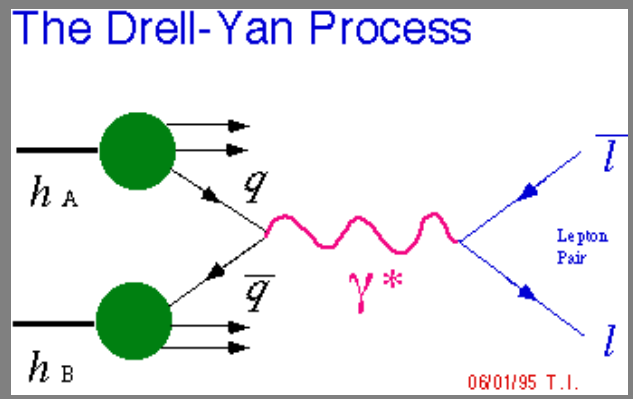
- J/Ψ expected suppression (Claimed by NA50)
- Υ bottomium family but the Luminosity might be too low with AuAu



Other fields of interest

- Open Charm (beauty) semi-leptonic decay : uncorrelated lepton
  - $D \rightarrow l + K + \nu$
  - $B \rightarrow l + D + \nu$
- Open Charms from charmonium give correlated leptons

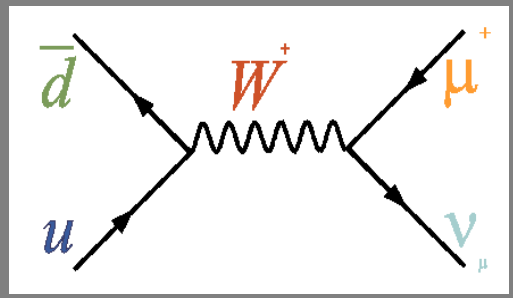




Spin Physics

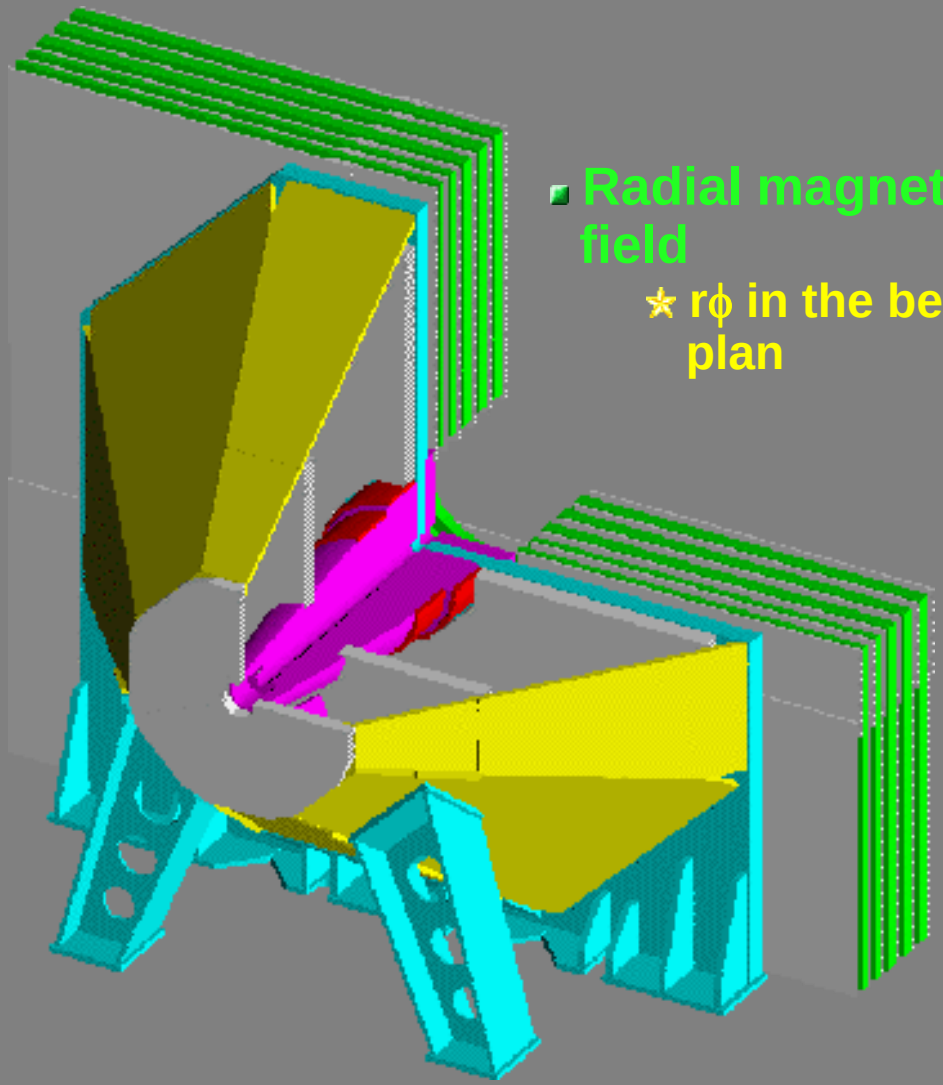
$$\text{Nucleon Spin} = \tfrac{1}{2} = \tfrac{1}{2}\,\Delta\Sigma + \Delta G + \Delta L$$

- **Spin (2005, $\sqrt{s}$ = 500 GeV ?)**
  - ★**~30% of the nucleon spin is distributed between quarks : $\Delta\Sigma \sim 0.3$**
  - ★**~70% should be carried by**
    - **Gluons**
    - **Movement of gluons and quarks relative to one another**
  - ★**Fields of study :**
    - **Gluon Polarization : Heavy Quarks**
    - **Sea-quark polarisation & Flavor dependence : W**

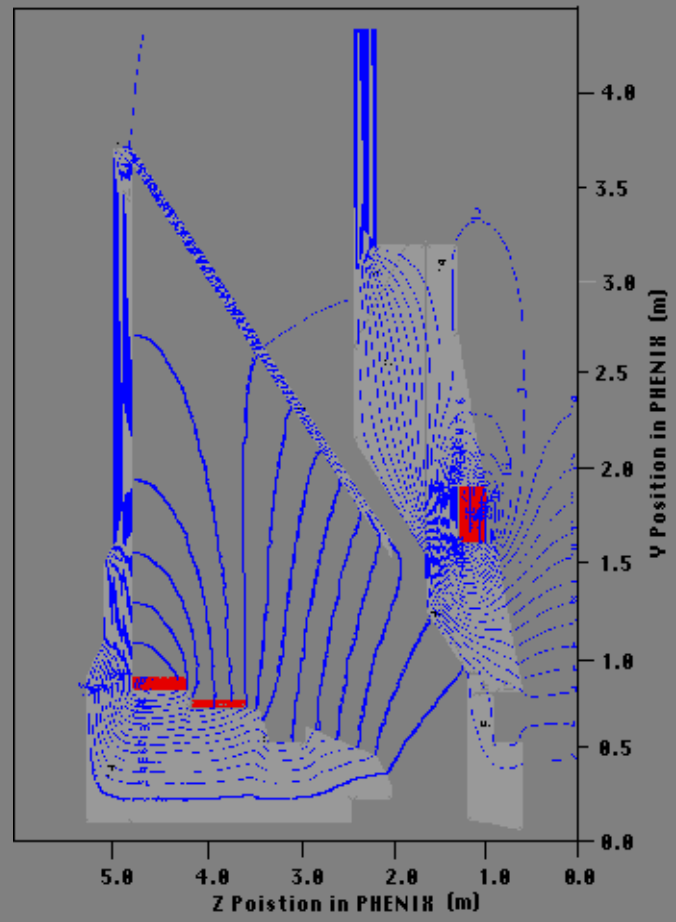



PHENIX

One Arm = three stations



- Radial magnetic field
  - ⋆ rϕ in the bending plan



One station : eight octants

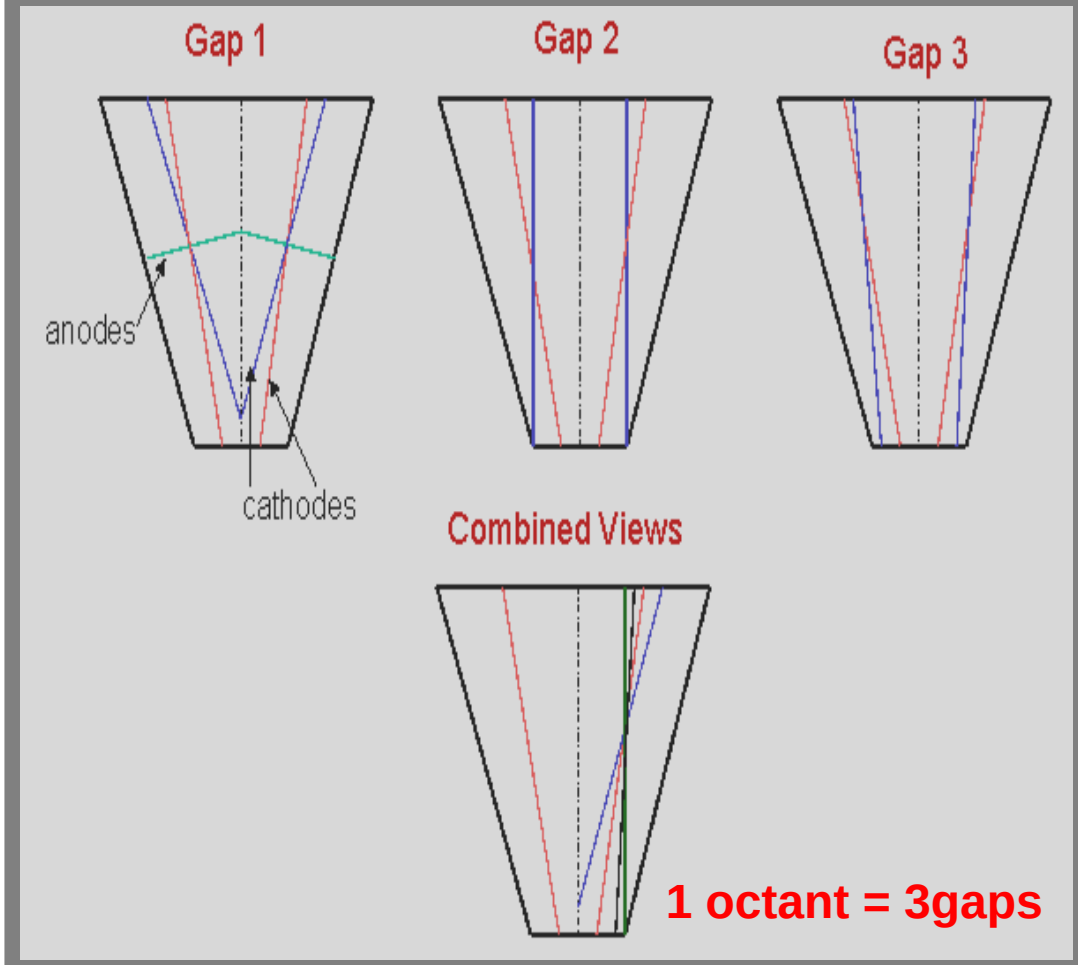
Station 1 : a quadrant

Station 3 : an octant

Station 2 : an octant

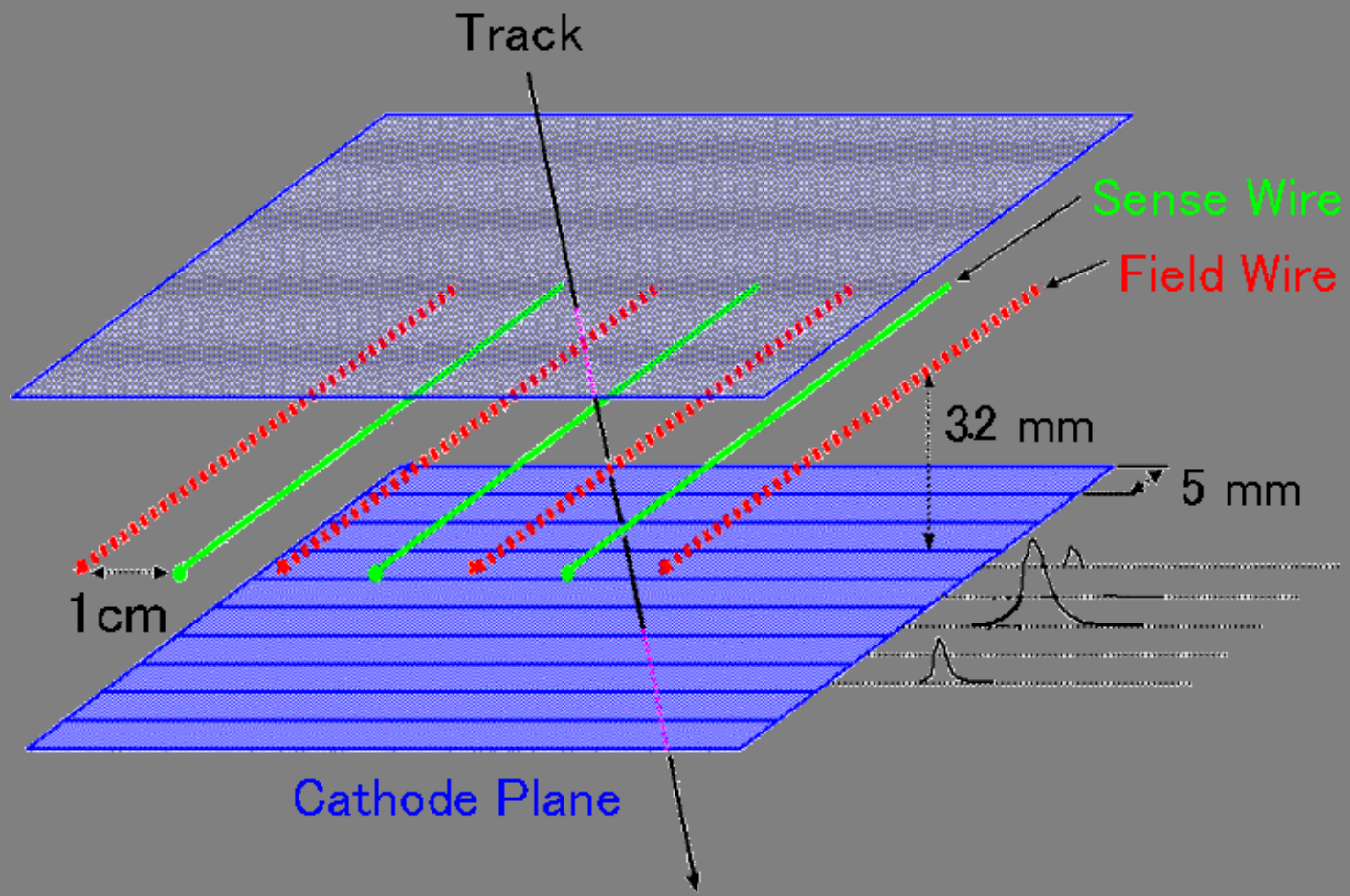
- Radiation length
  - Stations 1 & 3 < 10 %
  - Station 2 < 0.5 %

MuTr Octant



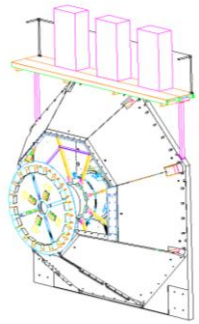
- **Gas Mixture :**
  - 50% Ar – 30% CO_2 – 20% CF_4
- **HV**
  - 1850 V – 1875 V – 1900 V
  - Gain : 2000
- **Cathode strip chamber**
  - Cathode strip spacing = 5 mm
  - Gas gap = 0.635 cm
  - Detector resolution :
    - 100 µm for cathodes perpendicular to anodes
    - Larger for cathodes at stereo angles.

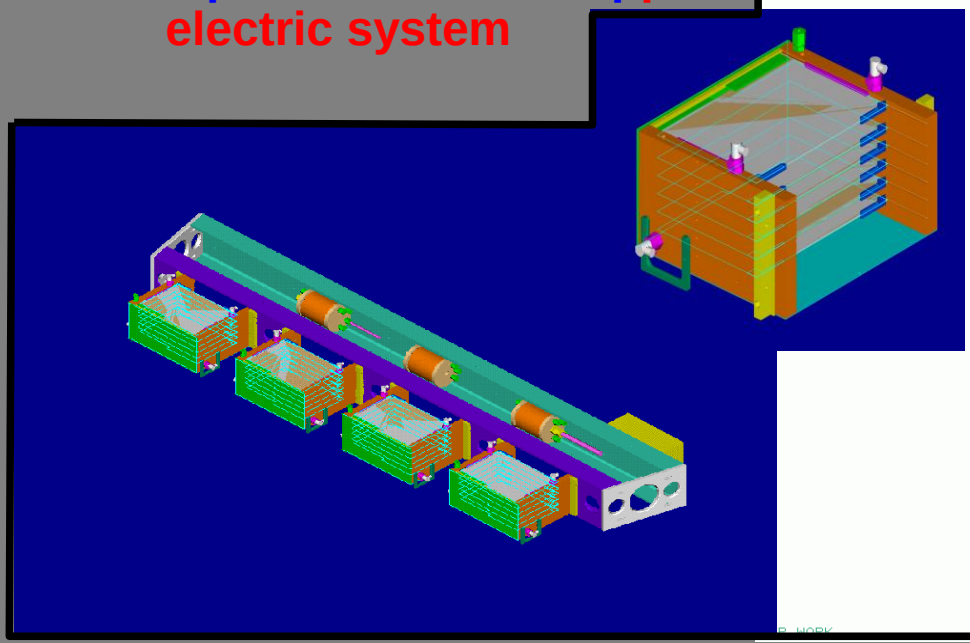
Within a gap

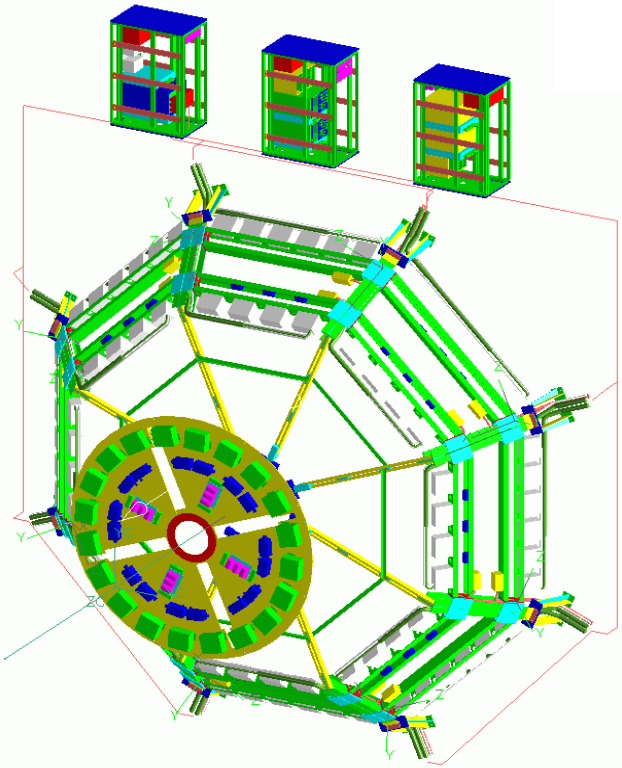


Electronics (South Arm)

- Cross rib
  - Cooling system
  - FEE
- Rack
  - HV distribution
  - Calibration system
  - Optical fiber <-> Copper electric system





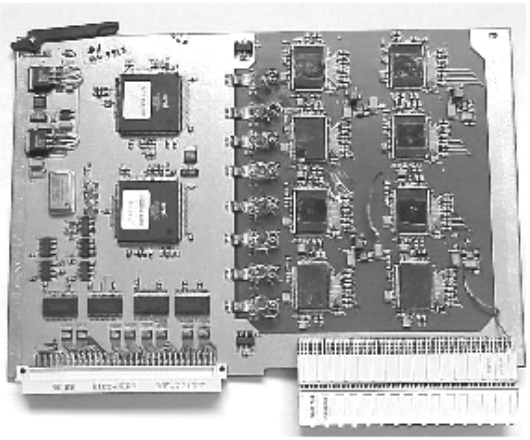


Cathode ReadOut Card (CROC)

requirements. Digital (3 pins), shaper (4 pins), Vmid (2 pins) and Preamplifier (1 pin). The preamplifier supply is the most critical and requires an additional large valued tantalum capacitor (22 uF 50 uF) to meet the noise requirements. All others require a 0.1 uF and a tantalum in the range of 1 uF 10 uF.

The gain was me
a precision pulser o
gain variation was
between 3.5 mV/fC

The noise was
550 µV and 650
The specified nois
within the specifica



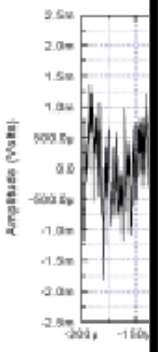


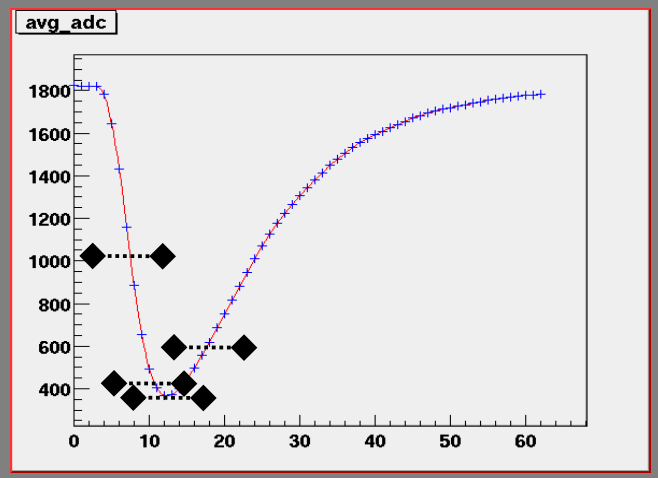
Figure 4: Front End Electronics Readout Card for Cathode Strip Detector (9.187" x 6.299" (233.35 mm x 160 mm))

Figure 6: Noise of a detector

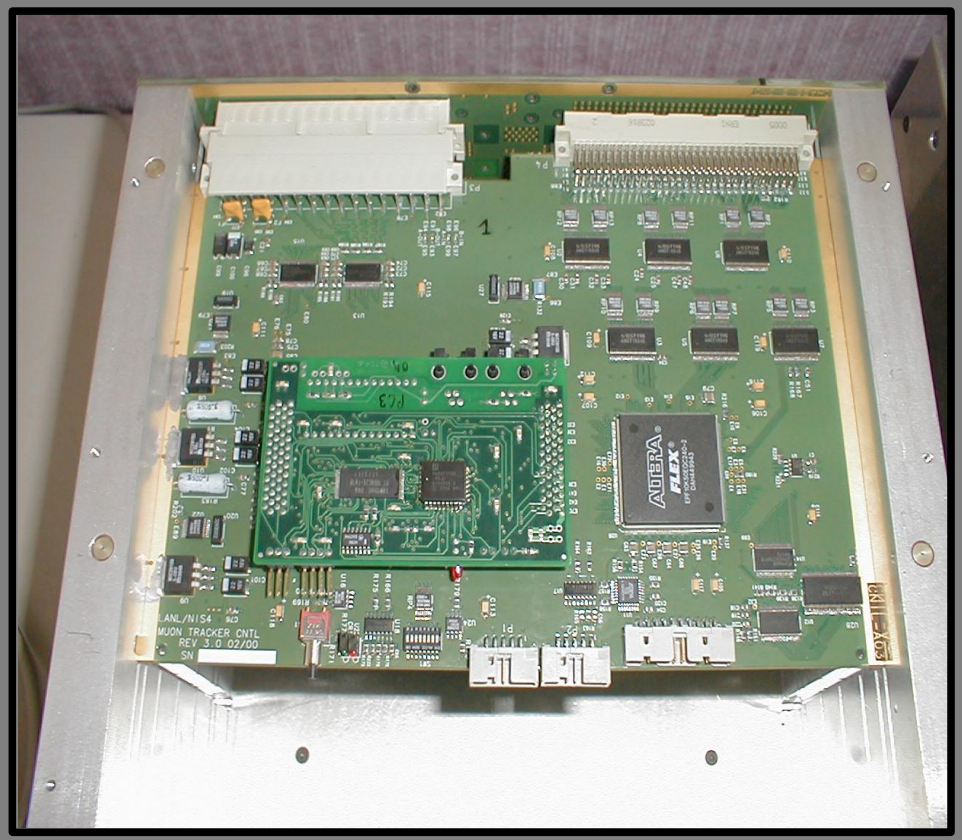
2) With detector a

The cable lengt
twisted pair and an

- 8 Cathode PreAmps :
  - 8 channels readout
  - Gain : 3.5 mV/fC
- 2 AMU/ADC
  - 4 samples

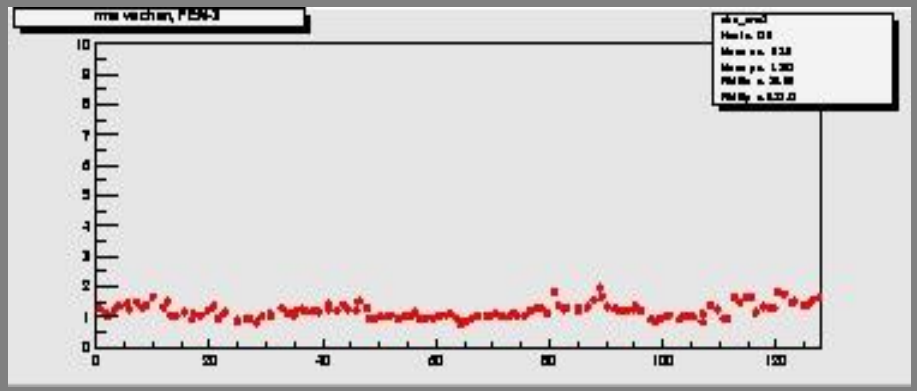


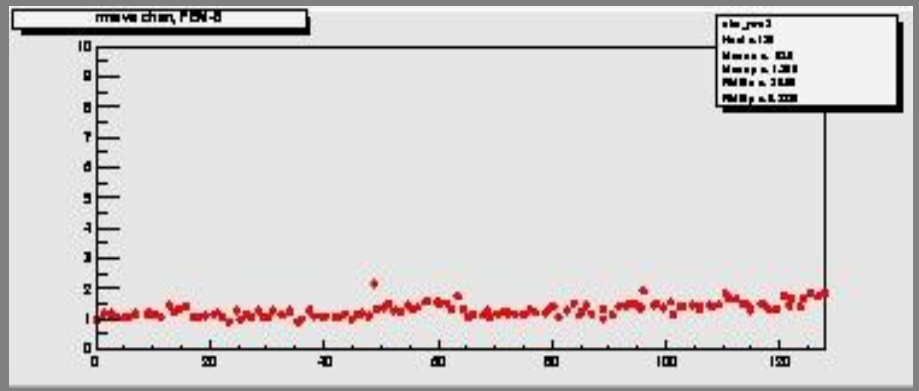
Controller Board

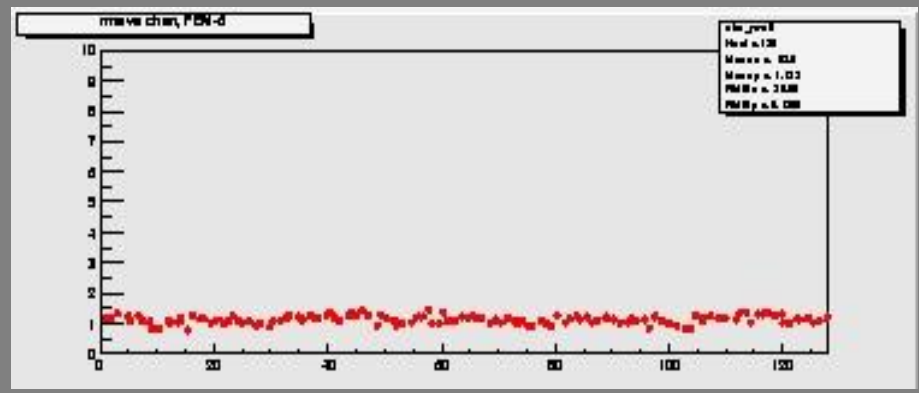


- Field Programmable Gate Array :
  - T&FC + DCM
  - AMU/ADC data
  - ARCNet communication
- ARCNet
  - Slow control (T°, low voltages)
  - Download the FPGA program

RMS of the Pedestals

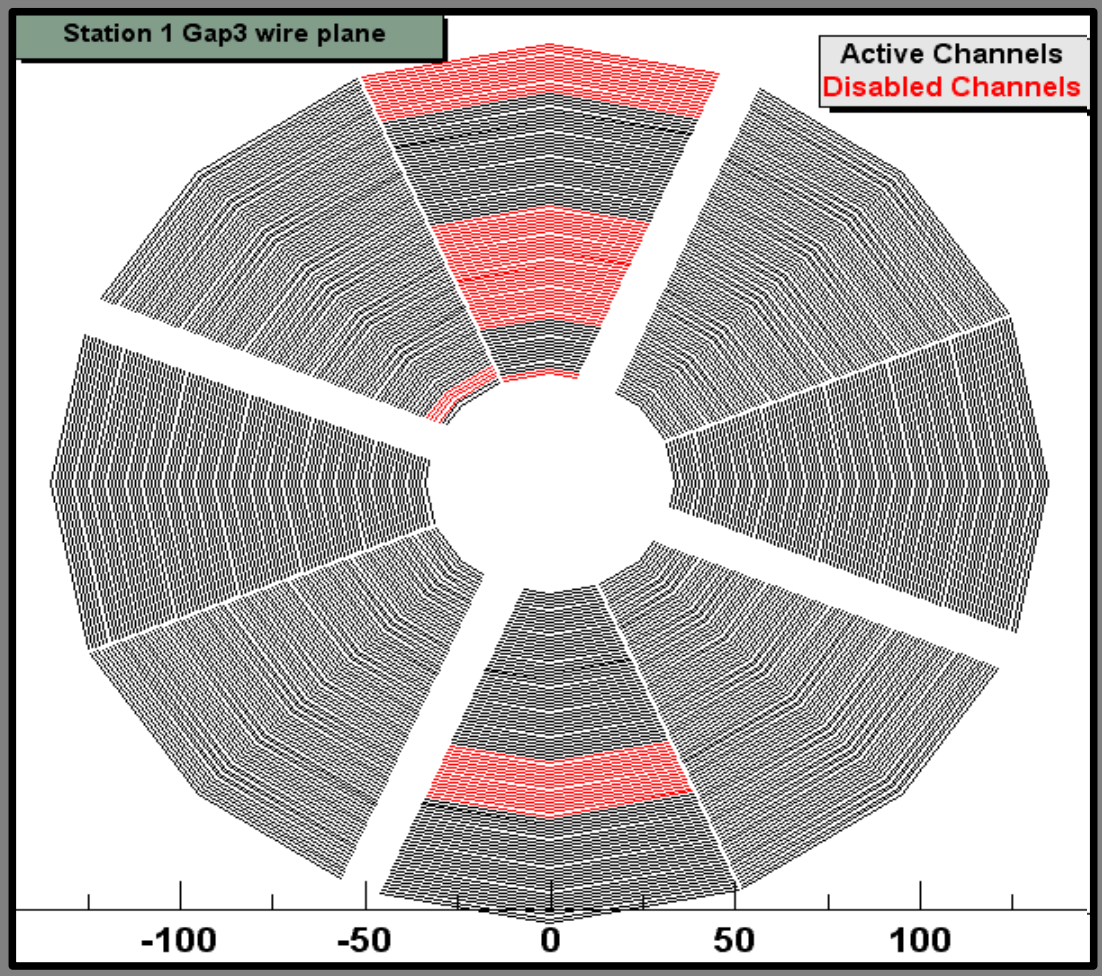




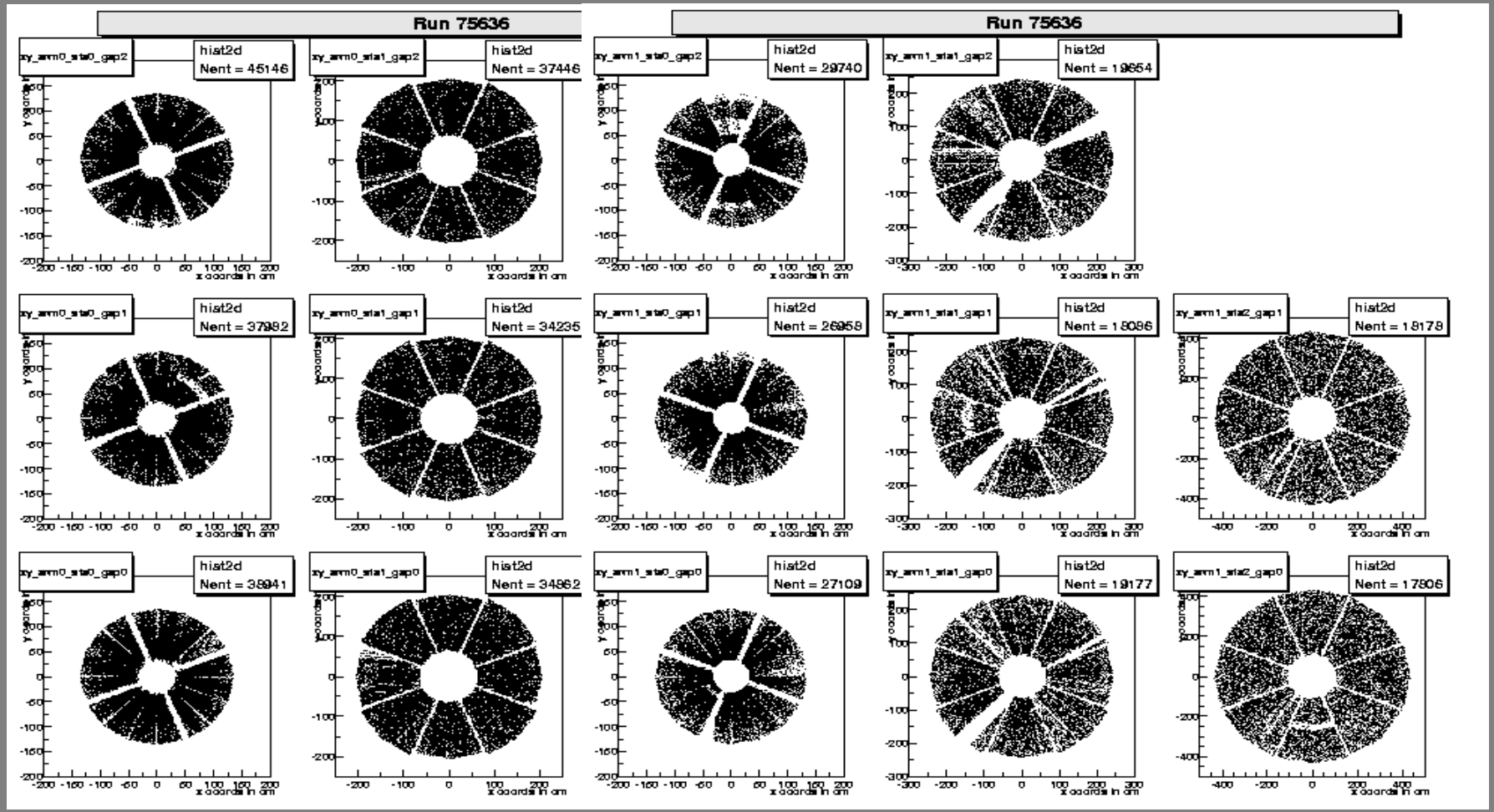


- RMS for the North Arm :
  - RMS < 1.5 ADC/channel (1 ADC count -> 0.5 fC)
  - Noise/signal < 1%

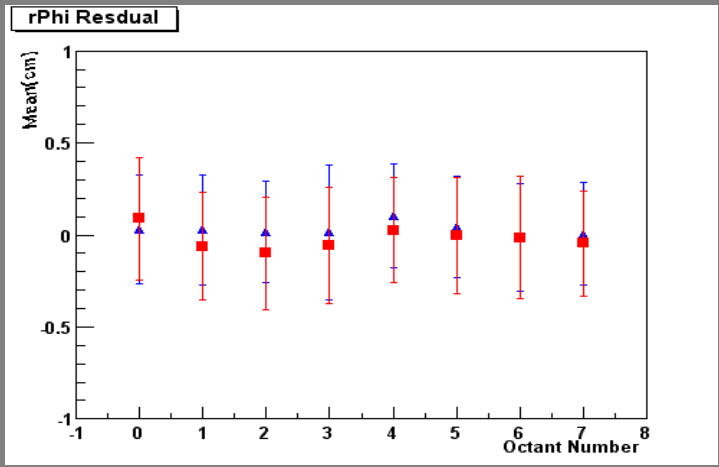
High Voltages (North Arm)



Radiograph

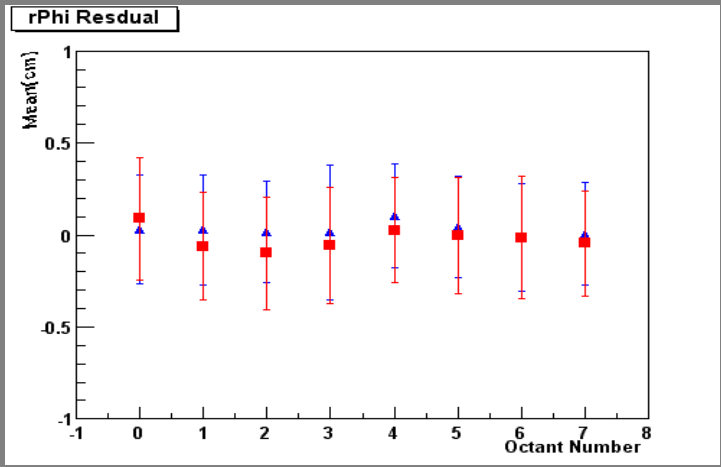

Run 75636
Run 75636
hist2d
Nent = 45146
hist2d
Nent = 37446
hist2d
Nent = 29740
hist2d
Nent = 19954
hist2d
Nent = 37992
hist2d
Nent = 34235
hist2d
Nent = 26958
hist2d
Nent = 18086
hist2d
Nent = 18178
hist2d
Nent = 36941
hist2d
Nent = 34862
hist2d
Nent = 27109
hist2d
Nent = 19177
hist2d
Nent = 17906

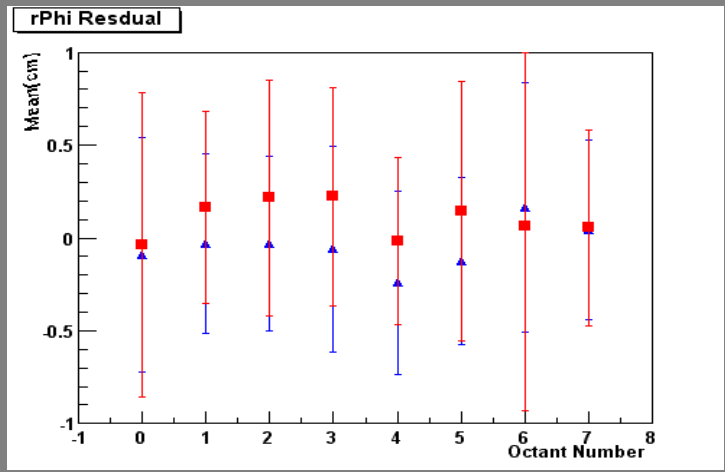
Resolution with Cosmic Studies



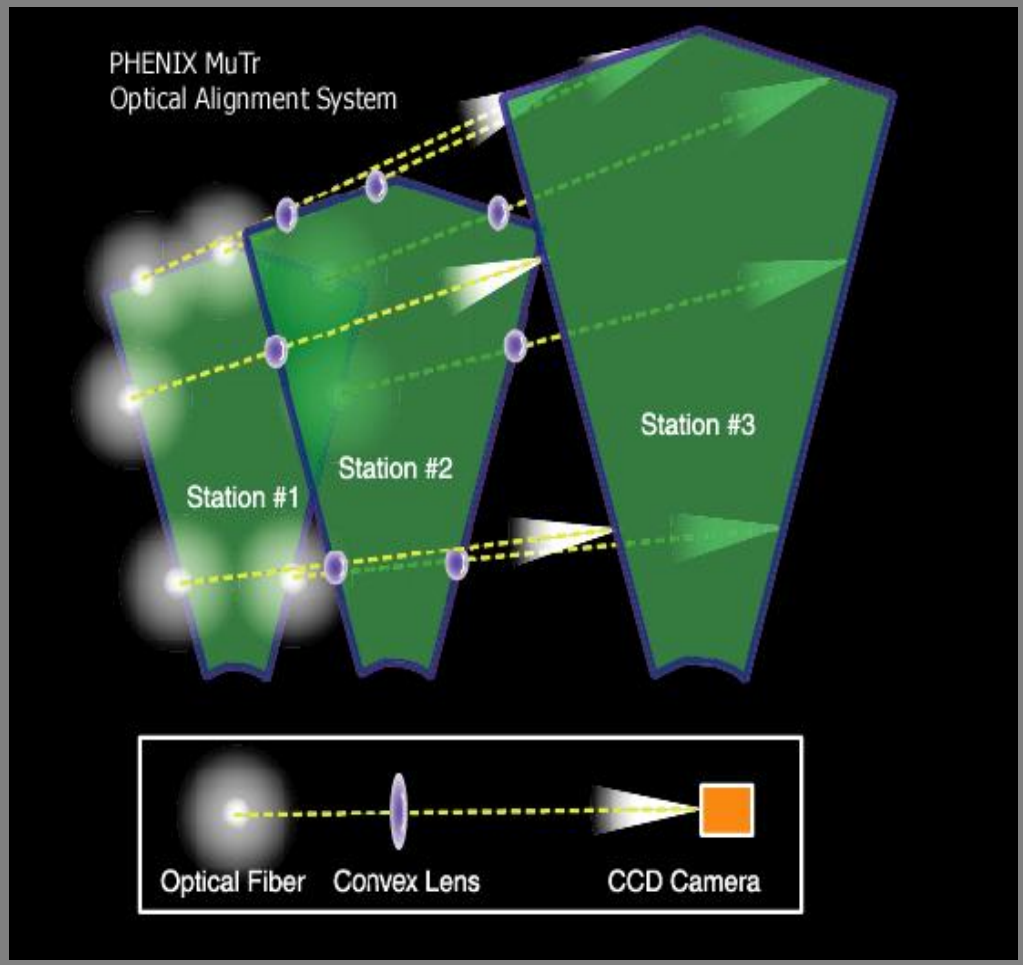
- North rφ residual
  - Blue : ½ Octant 0
  - Red : ½ Octant 1

(DongJo Kim)





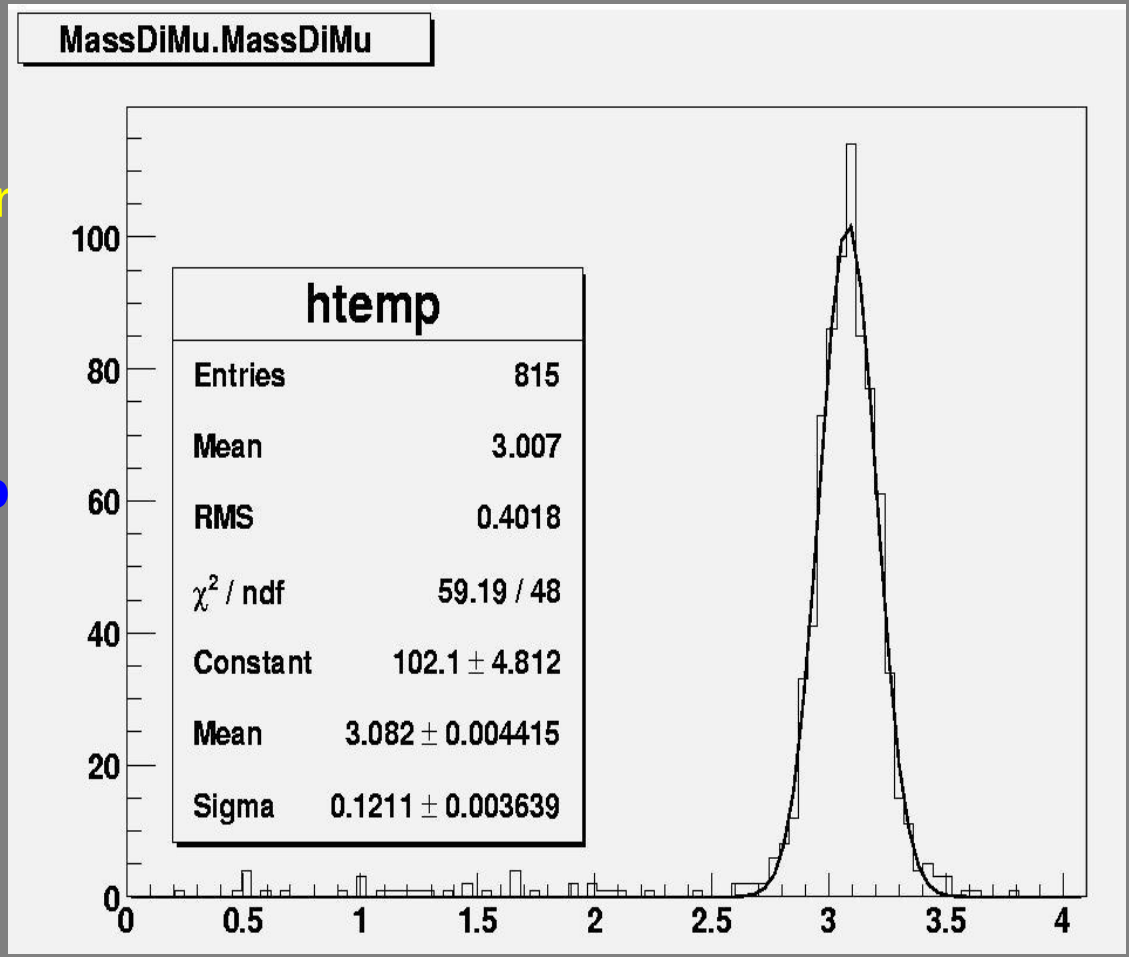
Alignment System



- Alignment Change by :
  - Magnetic field
  - Temperature
  - Mecanical relaxation
- Good monitoring of relative chamber positions, within ~ 25 µm
  - 7 cameras per octant

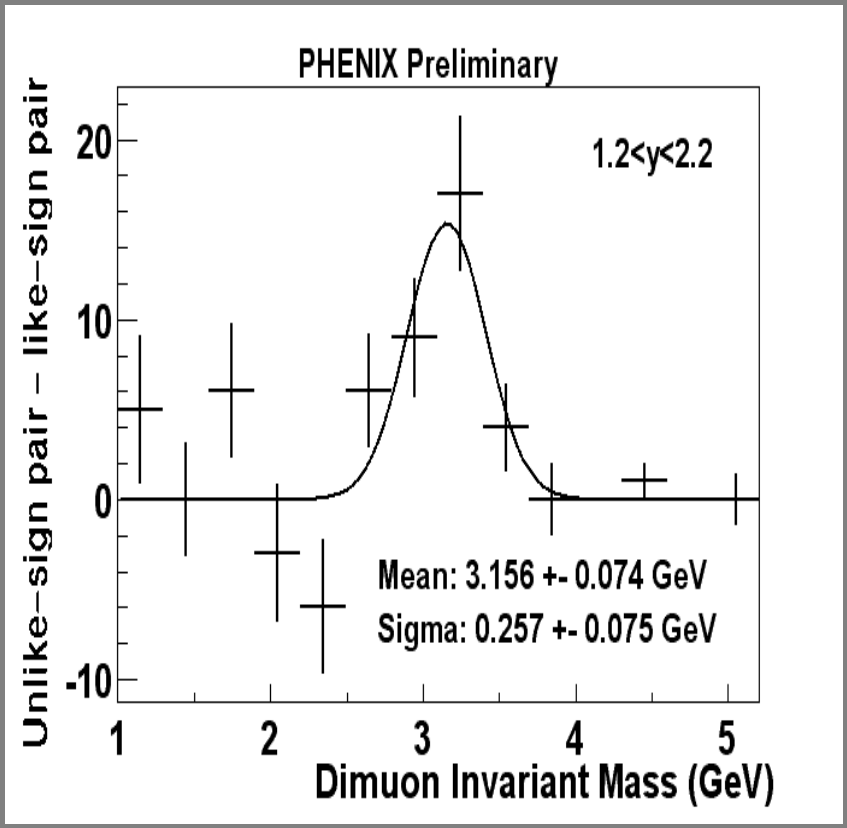
Software

- Two frameworks
  - offline/packets/mut
    - Pythia generation
    - 1000 J/ψ
    - Mass = 3.08 GeV
    - σ = 120 MeV
  - offline/packets/muto
    - In progress, but almost ready
    - Completely OO



First results with the South Arm

- p-p Collisions (QM02)



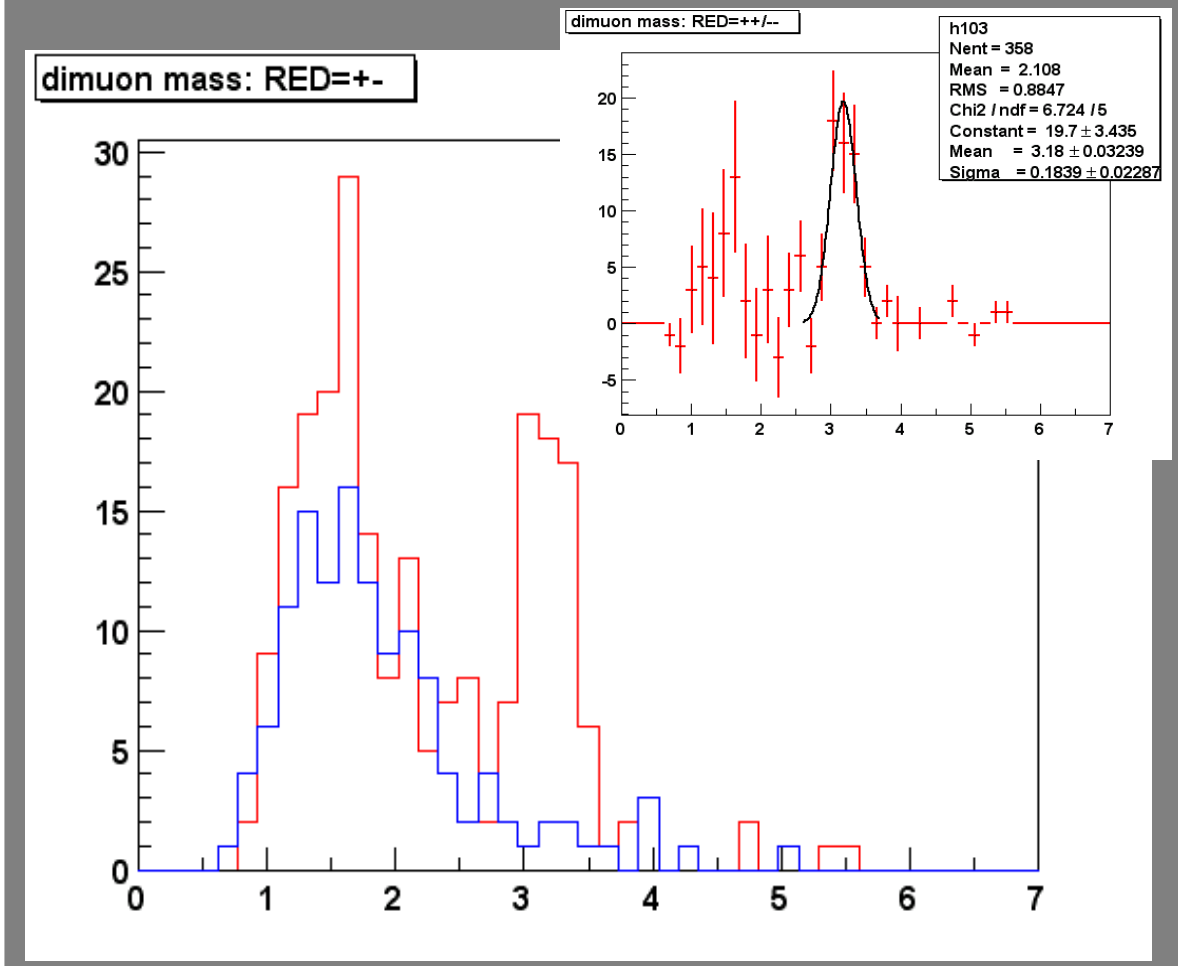
- PDG : J/Ψ ($\mu^+\mu^-$ = 6%)
  - Mass = 3096.88 MeV
  - σ = 0.09 MeV

- $J/\psi \rightarrow \mu^+ \mu^-$

  - pp minimum bias
  - $\sqrt{s}$ = 200 GeV
  - $1.2 < |\eta| < 2.2$
    - South Arm (Run II)
    - Mass ~ 3.19 GeV
    - Sigma ~ 257 MeV

Run II : new analysis

- p-p Collisions Run II

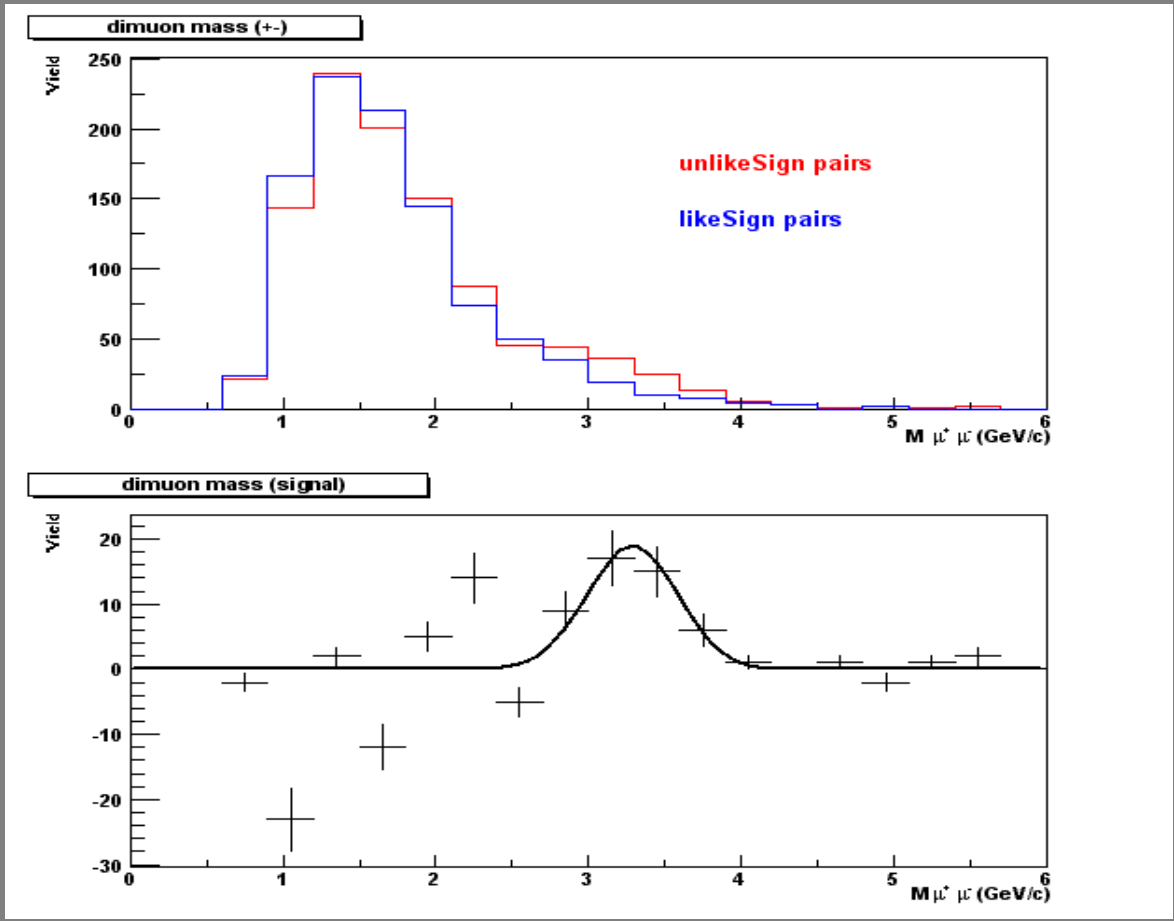


- PDG : J/Ψ ($\mu^+\mu^-$ = 6%)
  - Masse = 3096.88 MeV
  - σ = 0.09 MeV

- J/ψ → μ^+ μ^-
  - √s = 200 GeV
  - 59 J/ψ
    - 64% increase since QM
    - Mass ~ 3.18 GeV
    - Sigma ~ 180 MeV

Results with the South Arm (in progress !!)

- d-Au collisions (David Silvermyr)



- $J/\psi \rightarrow \mu^+ \mu^-$

★dAu minimum bias
★$\sqrt{s}$ = 200 GeV
★$1.2 < |\eta| < 2.2$

Muon Tracker Summary

- North arm is right now in order, everything seems stable
  - Low voltage
  - High Voltage
- Data collection
  - First good results from pp
  - Good beginning from dAu
- Upgrade
  - New detector in front of the nosecone ?
  - Second between the MuTr and the MuId ?
  - Anode readout ?
- Thanks


PHENIX